

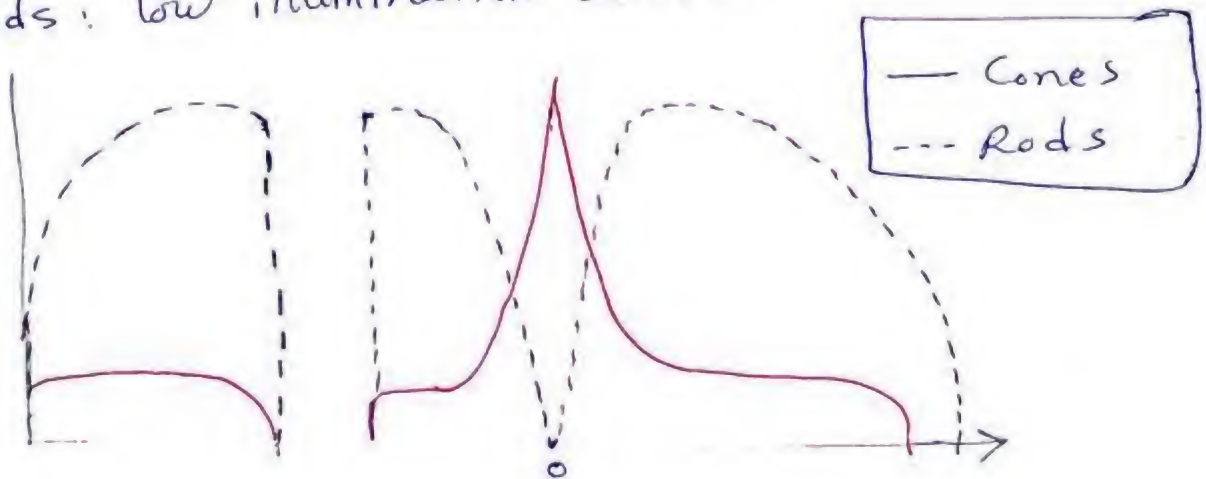
Lec-slide 2

"Human-visual-system-sensors"

* Retina: contain two-types of sensors

1) Cones: Color sensor

2) Rods: low illumination sensor.



* Focal-length

→ vary by change lens shape.

→ 14 mm for near object $\leq 3m$

→ 17 mm for object $> 3m$.

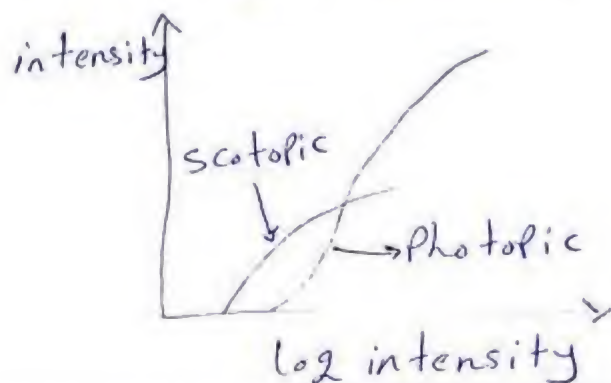
* Brightness-Adaption

→ The range of intensity that human can sense is varying from the scotopic threshold and the Glare limit.

→ the objective brightness is a log function of intensity.

⇒ Scotopic vision: low intensity, no-colors.

⇒ Photopic vision: High intensity, colored.



* Brightness discrimination

→ represent the ability of human to note the change in intensity.

→ varying from person to other.

→ measured with Weber ratio: the ratio between ΔI_c "change in intensity that can be detected" and I "intensity of background".

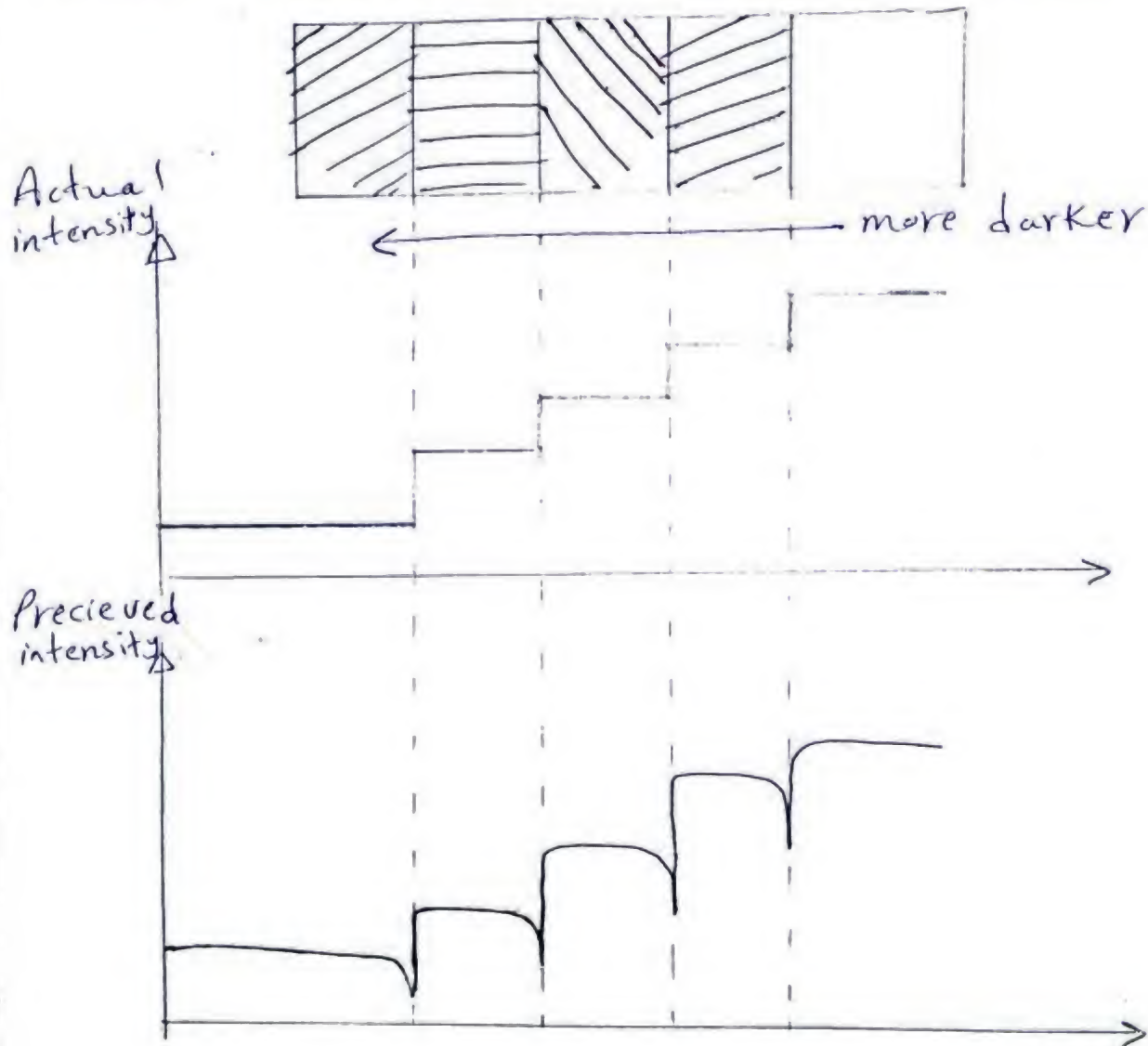
$$\text{Weber ratio} = \frac{\Delta I_c}{I}$$

Good discrimination ⇒ Small Weber ratio

Bad " ⇒ large Weber ratio.

* Brightness is not a simple function of the intensity:

→ the human visual system tends to ~~undershoot~~ or overshoot ~~at~~ at the boundary of Mach bands (regions of different intensities).



→ When the background of an object becomes more lighter the object looks more darker.

→ optical illusion.



Electro magnetic waves

→ Energy $E = h\nu$ $h \rightarrow$ Planck's constant
 $\nu \rightarrow$ Frequency

→ wavelength $\lambda = \frac{c}{\nu}$ (C: light speed
 $\hookrightarrow 2.998 \times 10^8$ m/s)

→ to see an object the wave length EM wave used as energy source must be the same ~~or~~ smaller than the object.

Light characteristics

- a) Monochromatic (achromatic) not colored
* intensity * Gray-levels.
- b) Chromatic (colored) light
* Radiance * Brightness * Luminance.

→

* Radiance: amount of energy flow from light source (watt)

* Luminance amount of energy perceived by observer from light source (Lumen) (lm)

Types of sensors

→ a) single-sensor

↳ resolution depends on the mechanical motion in the ~~both~~ ^{both} dimensions.

b) strip-sensor

↳ resolution depends on no. of sensors in one ~~the~~ dimension and the mechanical motion in the other

c) Ring-sensor

↳ used to take 3d image like in CAT.

d) Array sensor

↳ no mechanical motion.

↳ depends on no. of sensors in both dimensions.

Image model

$$0 < P(x, y) < \infty$$

$$P(x, y) = i(x, y) \cdot r(x, y)$$

$$0 < r(x, y) < 1 \quad , \quad 0 < i(x, y) < \infty$$

~~Activity~~

$$L_{\min} < P(x, y) < L_{\max}$$

$i(x, y)$ illumination

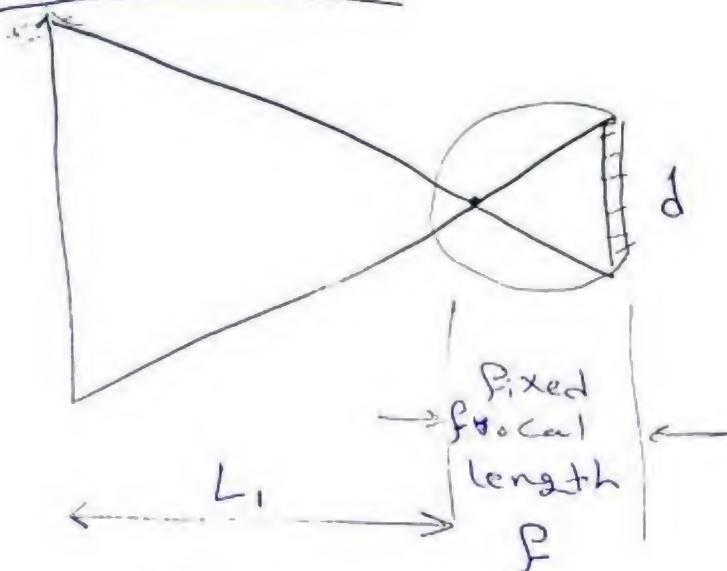
↳ the amount of energy fall on the surface of imaged object (lm/m^2)

$r(x, y)$ reflectance

↳ ability of object to reflect the fallen energy.

Sec 4

Image Processing



$L_1 > 3 \text{ m}$

$f = 17 \text{ mm}$

otherwise

$f = 14 \text{ mm}$

$$\frac{x}{L_1} = \frac{d}{f}$$

Light sensors

Cones Rods

- Colored vision
- need high illumination to work
- 6-7 million
- Concentrated.

- Colorless vision
- Can work in low level illumination
- 25-150 million
- Distributed.

